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E-I-STEAM

Intellectual Output 1

Data collection with the common problems in STEAM

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Summary of the Intellectual Output: Data collection

The goal of this intellectual output is identification of the contents in the students' books in Biology, Chemistry, Physics, Math, Technology, and Art which are most challenging for the students.

The teachers compared the contents of the curricula in the above mentioned subjects and used the results to question their students to define the most relevant and difficult units in the books. The results are part of the data collection which is comprised of different sections for each subject, and all of them are age specific.

The following schools participated in developing and administering the questionnaires to about 700 students:

- Douka Ekpaideftiria AE – Palladio Lykeion, Maroussi, Greece;
- I.T.I.S “Panella Vallauri”, Reggio di Calabria, Italy;
- SOU Gimnazija Koco Racin, Veles, North Macedonia;
- Zespół Szkół Kształcenia Ustawicznego, Krosno, Poland;
- Liceul Teoretic „Tudor Arghezi”, Craiova, Romania;
- IES Mediterraneo de Cartagena, Cartagena, Spain;

The other partners summarized the results and defined the topics and areas that are common for most of the schools:

- VEM srls, Reggio di Calabria, Italy;
- Cyprus Mathematical Society, Nicosia, Cyprus;
- ATLME, Barcelos, Portugal;

This data collection is a base for designing infographics in all partner languages as a teaching material.

IES Mediterraneo de Cartagena, Cartagena, Spain	Subject	Age 14-15	Age 16-17
	Math	<ul style="list-style-type: none"> • Functions • Stereometry 	<ul style="list-style-type: none"> • Trigonometry • Probability
	Physics	<ul style="list-style-type: none"> • Atomic Structure • Stoichiometry 	<ul style="list-style-type: none"> • Forces • Energy
	Biology	<ul style="list-style-type: none"> • Mitosis vs Meiosis • Mendel's third law 	<ul style="list-style-type: none"> • Cloning • Radiometric methods • Energy efficiency
	Art	<ul style="list-style-type: none"> • Metric geometry • Descriptive geometry • Form Analysis 	<ul style="list-style-type: none"> • Visual composition rules • Theory of color
	Technology	<ul style="list-style-type: none"> • Structures • Electricity • Use of Materials 	<ul style="list-style-type: none"> • Electronics • Types of energy

Liceul Teoretic „Tudor Arghezi” Craiova, Romania	Subject	Age 14-15	Age 15-16	Age 16-17
	Math	<ul style="list-style-type: none"> • The graphical interpretation of the function properties • Operations with vectors 	<ul style="list-style-type: none"> • The properties of the logarithmic and exponential functions • Inverse trigonometric functions 	<ul style="list-style-type: none"> • The role of the 2nd derivative in the study of functions
	Biology	<ul style="list-style-type: none"> • Mendelian laws of heredity • Cell division • Genetic mutations 	<ul style="list-style-type: none"> • The influence of environmental factors on photosynthesis • Structural and functional features of the central nervous system in vertebrates 	
	Tech – Informatics	<ul style="list-style-type: none"> • Combining correspondence 	<ul style="list-style-type: none"> • Functions in EXCEL • Queries in ACCESS 	<ul style="list-style-type: none"> • The use of programming languages
	Chemistry	<ul style="list-style-type: none"> • Acids and bases • Greases, soaps, detergents 	<ul style="list-style-type: none"> • Organic compounds with biological action 	
	Physics	<ul style="list-style-type: none"> • The law of universal attraction • The laws of conservation in mechanics 	<ul style="list-style-type: none"> • Thermal machines 	

Subject	15 years	16 years	17 years	18 years
Math	Algebraic expressions <ul style="list-style-type: none"> - Factorization - Algebraic fractions 	Quadratic Function Quadratic function, <ul style="list-style-type: none"> - Properties and graph - Vieta's formulas - Square inequalities 	Trigonometry <ul style="list-style-type: none"> - Graph of trigonometric functions - Trigonometric equations - Application of the sine and cosine theorem 	Sequences and progressions <ul style="list-style-type: none"> - The limit of a sequence
	Roots <ul style="list-style-type: none"> - Root operations - Irrational expressions 	Trigonometric functions <ul style="list-style-type: none"> - Sharp-angle in a rectangular triangle 	Exponential and logarithmic function <ul style="list-style-type: none"> - Exponential function graph - Graph of the logarithmic function - Exponential and logarithmic equations and inequalities 	Differential calculus <ul style="list-style-type: none"> - Application of derivatives - Examination of flow and graph of functions with derivatives
		Stereometry <ul style="list-style-type: none"> - Cross-sections of prisms and pyramids - Area and volume of truncated cones and pyramids 	Combinatory <ul style="list-style-type: none"> - The difference between permutations, variations and combinations - Applying combinatory in real life problems 	Probability <ul style="list-style-type: none"> - Conditional probability
			Analytical geometry <ul style="list-style-type: none"> - Mutual position of a line and a circle, an ellipse, a hyperbola and a parabola 	Functions and limit Reading properties of Real Functions on Graph: <ul style="list-style-type: none"> - Bounded and unbounded functions - Periodic functions - Even and odd functions - Convex and concave functions - Limits of real functions - Asymptotes of some curves

SOU Gimnazija Koco Racin, Veles, North Macedonia	Subject	15 years	16 years	17 years
	Physics	Gravity <ul style="list-style-type: none"> - Newton's law of gravity - Kepler's laws - Movement of satellites (Deriving the formula of Newton's law of gravity) Movement of planets and other space objects 1st and 2nd cosmic speed) 	Electric field <ul style="list-style-type: none"> - Coulomb's law - Electric potential - Electric capacity (Vacuum electric permittivity, Serial and parallel capacitor, Connection Superposition principle)	Modern physics <ul style="list-style-type: none"> - Laws of radiation - Bohr atomic theory - X rays - Quantum electronics - Radioactivity (Energy levels of atoms Quantum leaps, Nuclear reactions, Absorption and emission of radiation, Radioactive decay, C 14 method, Dosimetry)
		Molecular physics <ul style="list-style-type: none"> - Surface tension - Saturated and unsaturated steam Air humidity (Thermodynamic equilibrium, Monomolecular layer, Absolute humidity, Relative humidity)	Electric current <ul style="list-style-type: none"> - Electric resistance - Kirchhoff's laws - Resistors - Semiconductors (Serial and parallel resistor connection Own and mixed conductivity N type and p type semiconductors)	Physics of materials <ul style="list-style-type: none"> - Liquid crystals - Crystal structure of matter - Polymers (Phase transitions, Unit cell, Classification by symmetry, Defects and impurities, Polymerization)
		Thermodynamics <ul style="list-style-type: none"> - First principle of thermodynamics - Adiabatic processes (Carnot cycle, Carnot efficiency, Perpetuum mobile)	Oscillations <ul style="list-style-type: none"> - Mathematical pendulum - Physical pendulum - Damped and driven oscillations - Superposition of oscillations (Degree of freedom, Simple harmonic oscillator, Calculating the value of earth's acceleration)	
			Waves <ul style="list-style-type: none"> - Wave interference - Dispersion of light - Optical lenses - Spherical mirrors (Electromagnetic waves, Chromatic aberration Refractive index, Coherent waves Principle of superposition of waves, Mirrors and lenses constructions)	

Subject	15 years	16 years	17 years	18 years
Chemistry	Structure of the matter Structure of the atom and periodic table of the elements <ul style="list-style-type: none"> - Explaining the structure of an atom in terms of an orbital model - Represent the electronic configuration of the elements - The meaning of quantum numbers and combinations of quantum numbers for determination of atomic orbital - The structure of a periodic system of elements, the periodicity of the change in the physical and chemical properties of the elements by groups and periods - formation of chemical bonds 	Oxidation-reduction reactions Equations of oxidation- reduction reactions <ul style="list-style-type: none"> - Change in the degree of oxidation of element in chemical reactions - Determine the numbers of elements in the redox reaction, the number of released and received electrons, the oxidation and reduction agent - Balancing oxidation- reduction reaction equations 	Hydrocarbons Nomenclature and isomers of organic compounds <ul style="list-style-type: none"> - Nomenclature of organic compound by IUPAC - Branched hydrocarbon naming - Isomerism, formation of isomers of the saturated and unsaturated hydrocarbons 	Basic of the biochemistry Nucleic acids <ul style="list-style-type: none"> - Construction of DNA - Structure of DNA
	Structure of the matter Hybridization and hybrid orbitals <ul style="list-style-type: none"> - Formation of chemical bonds - Understanding the term hybridization - Formation of hybrid orbitals and their spatial arrangement 			

Veles, SOU Ginnazija Koco Racin, North Macedonia	Subject	15 years	16 years	17 years
	Biology	View of the wildlife Viruses <ul style="list-style-type: none"> - The lytic and lysogenic cycle of viruses 	Molecular Biology <ul style="list-style-type: none"> - Transmission of genetic information - Replication, transcription, translation, - Protein synthesis 	Nervous system <ul style="list-style-type: none"> - Vegetative nervous system - synapse Endocrine system <ul style="list-style-type: none"> - Hormones of the pancreas - regulation of insulin and glucagon secretion - Adrenal glands - secretory regulation of glucocorticoids - Thyroid gland - regulation of thyroid hormones - Adenohypophysis - regulation of adenohypophysis function

I.T.I.S “Panella Vallauri” Reggio di Calabria Italy	Subject	Age 15	Age 16	Age 17
	Math	<ul style="list-style-type: none"> - Monomials polynomials - Ruffini theorem - Euclidean geometry 	<ul style="list-style-type: none"> - Inequalities first grade - Equation second grade - Cartesian plane 	<ul style="list-style-type: none"> - System Equations - Radicals - Trigonometry
	Chemistry	<ul style="list-style-type: none"> - Atom - Dalton's law - Physical states of matter 	<ul style="list-style-type: none"> - Periodic table - Avogadro's law - Nomenclature of chemical compounds 	
	Physics	<ul style="list-style-type: none"> - Unit of measure - Forces - Solid balance 	<ul style="list-style-type: none"> - Uniform straight motion - Dynamics principles - Electricity 	
Technology				<ul style="list-style-type: none"> - Production process - Systems and materials - Practical applications

Douka Ekpaideftiria AE Palladio Lykeion, Maroussi Greece	Subject	Age 14-15	Age 15-16	Age 16-17
	Math	<ul style="list-style-type: none"> - Expressions - Factorisation - Power - Equations - Functions - Probability 	<ul style="list-style-type: none"> - Real Numbers, Power, Roots - Functions - Graphs - Probability - Symmetry - Tessellations, 	<ul style="list-style-type: none"> - Polynomials - Scaling, - Rotation - Reflection - Translation
	Physics	<ul style="list-style-type: none"> - Light - Reflection, Refraction - Electric Current - Energy 	<ul style="list-style-type: none"> - Forces-Newton's laws - Energy Conservation - Electric Current, Kirchhoff, Ohm 	<ul style="list-style-type: none"> - Electric Forces - Light - Velocity, Wavelength - Electric Current, Kirchhoff, Ohm
	Chemistry	<ul style="list-style-type: none"> - Periodic Table - Acids, Bases, Salts 	<ul style="list-style-type: none"> - Structure of Atom - Periodic Table - Acids, Bases, Salts 	<ul style="list-style-type: none"> - Chemical Reactions
	Biology	<ul style="list-style-type: none"> - Life Conservation - Biotechnology - Evolution of species 	<ul style="list-style-type: none"> - Cells, Tissues, Organs - Circulatory 	<ul style="list-style-type: none"> - Genetic
	Tech - Informatics	<ul style="list-style-type: none"> - Programing-Coding - Creation-Communication Apps 	<ul style="list-style-type: none"> - Cycle of Application Development - Creation-Communication Apps - Internet Services - Applications 	<ul style="list-style-type: none"> - Programing-Coding - Networks - A.I.

Subject	Age 16-17	Age 17-18	Age 18-19
Math	<ul style="list-style-type: none"> - Transforming the graph of the logarithmic function - Mutual location of two circles - A diagonal angle in prisms and pyramids 	<ul style="list-style-type: none"> - Polynomial inequalities - Exponential inequalities - Cross-sections of prisms, pyramids - Calculation of event probabilities using the "tree" method 	<ul style="list-style-type: none"> - Graphs of polynomials - Reduction formulas - "Stretching", "compression" along the axis of the coordinate system - Absolute value transformations - Mutual position of the straight line and the circle
Physics	<ul style="list-style-type: none"> - Kepler's laws - Body radiation 	<ul style="list-style-type: none"> - External photoelectric effect - Radioactive decay - Nuclear reactions - Hubble's law 	<ul style="list-style-type: none"> - Measuring the distance to the moon, planets and stars - Nuclear radiation and its properties - The interaction of radiation with matter
Biology	<ul style="list-style-type: none"> - DNA analysis and their use in science, judiciary and medicine - Biodiversity at different levels of nature organization - Examples of international cooperation to prevent threats to nature 	<ul style="list-style-type: none"> - Genetic modification of microorganisms, plants and animals - The course of gene therapy and the possibilities of its use in the treatment of hereditary and cancer diseases 	<ul style="list-style-type: none"> - Bioremediation methods of heavy metals by microorganisms - A method of mammalian cloning called cell nuclear transfer - Basic types of legal acts in force in the European Union
Chemistry	<ul style="list-style-type: none"> - Salt formation reactions - Catalysts and catalytic reactions - Chemical properties of amino acids 	<ul style="list-style-type: none"> - Hybridization of atomic orbitals - Rule of Defiance - Formation of a glyosidic bond 	<ul style="list-style-type: none"> - Response rate-calculations - Reactions of carboxylic acids with metals, metal oxides, hydroxides and alcohols - Fischer and Haworth patterns